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Vaccination During Pregnancy in the Vaccine Safety Datalink, 2002–2022

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Abstract

We described vaccinations during pregnancies starting in 2002 through 2022 in 8 Vaccine Safety Datalink (VSD) healthcare organizations in the United States. During this period, the number of vaccinations per pregnancy increased, influenza and Tdap were the most frequently administered vaccines, and administration of contraindicated vaccines was infrequent. The VSD can provide information about real-world implementation of vaccination recommendations for pregnant people.

Keywords

pregnancy; vaccination trends; public health; delivery of healthcare

INTRODUCTION

Public health officials in the United States have recommended influenza vaccination for pregnant people since 1960, but the first recommendation by the Advisory Committee on Immunization Practices (ACIP) for influenza vaccine administration during pregnancy was made in 1997.¹ Three other vaccines, including those to prevent tetanus-diphtheria-acellular pertussis (Tdap) in 2011,² coronavirus disease 2019 (COVID-19) caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) in 2021,³ and respiratory syncytial virus (RSV) in 2023,⁴ have since been recommended for pregnant people. Several vaccines, including human papillomavirus (HPV) vaccine and live viral vaccines like varicella, are not recommended during pregnancy.⁵ Hepatitis B, hepatitis A, and travel vaccines may be administered if the pregnant person is at risk.⁵ The Vaccine Safety Datalink (VSD),⁶ a collaboration between 13 healthcare organizations and the Centers for Disease Control and Prevention (CDC), monitors vaccination, including during pregnancy, to assess coverage and safety and to inform public health officials about the uptake of these vaccines.

MATERIALS AND METHODS

The VSD uses two validated algorithms to identify ongoing and completed pregnancies, including those ending in non-live births (e.g., spontaneous abortion, stillbirth).⁷ The algorithms estimate gestational age, pregnancy start date, and end date using data from electronic health records (EHR), insurance claims, linked birth certificates, and administrative databases. For this analysis, we identified completed pregnancies (i.e., those that ended in live births, non-live births, or terminations) that started January 1, 2002 through December 31, 2022 among people 12 through 55 years of age. Eight VSD sites contributed data to this analysis: Denver Health [CO], HealthPartners [MN], Marshfield Clinic [WI], and the Colorado, Northern California, Northwest [OR/WA], Southern California, and Washington Kaiser Permanente regions. Two of these sites were not able to contribute data for the full study period.

To describe the uptake of vaccination during pregnancy, we identified all vaccines received during the pregnancies in the study period, excluding those received on the pregnancy end date. Vaccination data were extracted from EHR, insurance claims, and linked

regional and state immunization information systems (IIS).⁸ We excluded vaccine records that were implausible based on calendar date and product availability (e.g., COVID-19 vaccine administered in 2012), experimental vaccines, and non-vaccine products, such as immunoglobulins. We described vaccines received by trimester (1st trimester=less than 14 weeks' gestation, 2nd trimester=14 through less than 28 weeks' gestation, 3rd trimester=28 weeks' gestation through the pregnancy end date) based on the gestational age estimated by the algorithms. We also calculated the average number of vaccines administered during pregnancy annually by dividing the number of vaccines administered during pregnancy by the number of pregnancies that started in each calendar year. This study was approved by the institutional review boards of all participating sites with a waiver of informed consent because this was a minimal risk observational study and was conducted consistent with federal law and CDC policy (see 45 C.F.R. part 46.114; 21 C.F.R. part 56.114).

RESULTS

Over the study period, we identified 2,943,789 completed pregnancies among people 12 through 55 years of age, and 2,472,612 vaccinations during those pregnancies (Table). The average number of pregnancies identified each year was 140,180 and ranged from 104,434 (2003) to 163,026 (2021). We excluded 175 vaccine records with implausible dates (172 novel pandemic monovalent H1N1 influenza, 2 COVID-19, 1 HPV), and 153 records of non-vaccine products administered during pregnancy. The average number of vaccinations per pregnancy increased from 0.07 in 2002 to 1.35 in 2022, with larger increases noted in 2009, 2013, 2014, and 2021. The average number peaked in 2021 at 1.86 when the primary COVID-19 series was widely available in the United States.

Inactivated seasonal influenza (1,122,749 doses) and Tdap (1,067,739 doses) vaccines accounted for 89% of all vaccinations received during pregnancy during the study period (Table). From 2020 through 2022, 164,043 doses of COVID-19 vaccines were administered during pregnancy. In 2009 and 2010, 48,610 doses of pandemic monovalent H1N1 influenza vaccine were administered. Other vaccines administered included: hepatitis B (23,100 doses), HPV (9,991 doses), tetanus-diphtheria (Td) (8,701 doses), hepatitis A (4,876 doses), pneumococcal (4,744 doses), and measles-mumps-rubella (MMR) (3,082 doses). An additional 13,162 vaccine doses were categorized as "other". Included in this "other" category were live viral vaccines contraindicated during pregnancy: 2,247 doses of varicella vaccine, 1,824 doses of live attenuated influenza vaccine (LAIV), 29 doses of zoster vaccine, and 18 doses of smallpox (vaccinia) vaccine (data not shown).

The timing of vaccination during pregnancy varied by vaccine (Table). Consistent with ACIP recommendations, influenza and COVID-19 vaccinations occurred across trimesters, and 82% of Tdap vaccines were given during the 3rd trimester. For vaccines contraindicated or not recommended during pregnancy, 91% of HPV, 86% of smallpox, 73% of varicella, 72% of LAIV, 60% of MMR, and 59% of zoster vaccinations occurred in the 1st trimester (data not shown for smallpox, varicella, LAIV, and zoster vaccines).

DISCUSSION

From 2002 through 2022, increases in the number of vaccinations administered per pregnancy were observed in the VSD, particularly following the introduction of pandemic vaccines (H1N1 influenza in 2009 and COVID-19 in 2020), and the 2013 updated recommendation for Tdap vaccination during every pregnancy.⁹ These observed increases do not represent increased vaccination coverage during pregnancy, but instead reflect the increasing number of vaccines approved or recommended for use during pregnancy. Seasonal influenza and Tdap vaccines accounted for 89% of all vaccinations administered during pregnancy.

Four vaccines are currently recommended during pregnancy in the United States,⁵ and additional vaccines may soon be licensed and recommended for use during pregnancy. The VSD will continue to monitor vaccination trends and safety during pregnancy and is well-positioned to provide timely estimates of vaccine uptake during pandemics or after new products are licensed and recommended.

VSD data presented here suggest that the timing of inactivated influenza, Tdap, and COVID-19 vaccine administration is largely consistent with ACIP recommendations for pregnant people. Some vaccines that are not recommended or are contraindicated for pregnant people, such as HPV and varicella, are also being administered during pregnancy, but the pattern of primarily 1st trimester administration suggests that these vaccines may be received before the patient and/or provider are aware of the pregnancy.

This study is subject to several possible limitations. First, pregnant people included in the VSD are usually insured and receive health care during pregnancy; therefore, the vaccination patterns observed in this population may not be generalizable to those who are uninsured and/or not receiving care. While the populations included in the VSD are generally representative of the underlying communities at each VSD site,¹⁰ results may not be generalizable to other geographic regions of the United States that might have higher or lower rates of vaccination. Second, although the pregnancy algorithms have been shown to have high rates of agreement with medical record review, some misclassification of pregnancy start and end dates is possible.⁷ Third, vaccine records and administration dates may also be impacted by misclassification, although we excluded vaccines that were implausible based on administration dates and product availability. Fourth, VSD includes several sources of vaccine data, including EHR, insurance claims, and linked IIS, but it is possible that vaccines administered outside of participating healthcare systems were not captured, which would result in underestimates of vaccine uptake. Finally, because our study period ended with the 2022 calendar year, we did not describe uptake of the recently recommended RSV vaccine in this study. However, the VSD is monitoring RSV vaccine uptake and data are publicly available on the CDC's RSVVaxView webpage (<https://www.cdc.gov/vaccines/imz-managers/coverage/rsvvaxview/>). Additionally, the VSD publishes detailed weekly seasonal influenza and COVID-19 coverage data on the CDC's FluVaxView webpage (<https://www.cdc.gov/flu/fluview/>) and COVIDVaxView webpage (<https://www.cdc.gov/vaccines/imz-managers/coverage/covidvaxview/>), respectively.

The VSD provides timely information about real-world implementation of vaccination recommendations for pregnant people, including uptake of vaccines during pandemics. These data can also highlight adherence to vaccination recommendations and can be used to monitor administration of vaccines that are not recommended or are contraindicated during pregnancy.

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Conflict of interest and source of funding:

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Disclaimer:

The findings and conclusions in this report are those of the authors and do not necessarily represent the official position of the Centers for Disease Control and Prevention.

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TABLE.

Vaccines Administered during Pregnancy, Vaccine Safety Datalink, 2002–2022*

Year	Pregnancies ^{\$}	Influenza	Tdap	COVID-19	H1N1	Hep B	HPV	Td	Pneumo	Hep A	MMR	Other [#]	Total	Vax per preg [^]
2002	108,771	5,996	3	0	0	496	0	430	65	186	161	249	7,587	0.07
2003	104,434	11,169	12	0	0	474	0	761	48	234	243	354	13,301	0.13
2004	114,821	19,095	16	0	0	545	0	1,396	62	244	373	436	22,216	0.19
2005	121,109	20,366	61	0	0	582	0	1,300	71	264	132	558	23,365	0.19
2006	127,200	23,862	601	0	0	586	87	1,060	73	293	84	652	27,333	0.21
2007	127,756	27,383	1,055	0	0	704	902	648	96	324	79	721	31,945	0.25
2008	129,588	30,778	1,621	0	0	1,082	1,042	469	76	236	80	580	36,052	0.28
2009	129,025	50,350	1,971	0	40,643	1,150	818	458	115	228	76	529	96,562	0.75
2010	136,828	47,757	21,983	0	7,967	1,154	583	389	125	238	102	860	81,316	0.59
2011	139,634	53,798	24,169	0	0	1,223	666	234	187	225	93	687	81,480	0.58
2012	140,843	58,849	25,034	0	0	1,249	810	161	395	174	108	759	87,714	0.62
2013	142,875	66,275	58,831	0	0	1,351	680	160	370	267	118	793	129,005	0.90
2014	148,272	74,113	92,887	0	0	1,413	710	118	363	248	149	834	171,048	1.15
2015	153,876	71,606	98,174	0	0	1,442	569	157	308	262	159	821	173,630	1.13
2016	157,089	76,838	102,586	0	0	1,480	688	149	343	222	197	786	183,328	1.17
2017	159,814	79,523	105,072	0	0	1,593	575	151	333	342	177	724	188,519	1.18
2018	162,244	87,505	107,728	0	0	1,579	433	180	371	294	170	684	198,981	1.23
2019	161,708	91,793	109,952	0	0	1,703	472	183	366	278	208	765	205,767	1.27
2020	160,507	90,301	106,772	1,313	0	1,456	292	110	322	99	118	409	201,229	1.25
2021	163,026	70,204	106,962	123,526	0	1,000	343	94	283	92	139	438	303,142	1.86
2022	154,369	65,188	102,249	39,204	0	838	321	93	372	117	116	523	209,092	1.35
Total	2,943,789	1,122,749	1,067,739	164,043	48,610	23,100	9,991	8,701	4,744	4,867	3,082	13,162	2,472,612	0.87
Timing of Vaccination														
1 st trimester	36%	2%	37%	37%	37%	44%	91%	56%	64%	72%	60%			
2 nd trimester	34%	16%	34%	34%	35%	36%	6%	25%	20%	22%	13%			
3 rd trimester	31%	82%	29%	29%	28%	20%	3%	19%	16%	6%	27%			

* Six VSD sites contributed data in 2002 and 2003, seven sites contributed data from 2004 through 2007, and eight sites contributed data from 2008 through 2022.

§ Number of pregnancies with start dates identified in the specific calendar year.

Other includes 72 unique CVX vaccine codes (<https://www2a.cdc.gov/vaccines/jis/istandards/vaccines.asp?pt=cvx>), each with less than 3,000 doses administered during the study period (range 1–2,247).

^ Vaccines administered during pregnancy in a specific calendar year divided by the number of pregnancies starting in that calendar year.

Abbreviations: Influenza=seasonal inactivated influenza vaccine; Tdap=tetanus-diphtheria-acellular pertussis vaccine; H1N1=2009 pandemic monovalent H1N1 influenza vaccine; Hep B=hepatitis B vaccine; HPV=human papillomavirus vaccine; Td=tetanus-diphtheria vaccine; Pneumo=pneumococcal conjugate vaccine; Hep A=hepatitis A vaccine; MMR=measles-mumps-rubella vaccine; Vax per preg=vaccinations per pregnancy